PATENT SPECIFICATION

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Inventor:—ALFRED WILLIAM CROOK

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COMPLETE SPECIFICATION.

Improvements relating to Supports for Large Structures.

We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, a British Company, having its registered office at Crown House, Aldwych, London, W.C.2, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the supporting of structures which are subject to extension, e.g. as a result of temperature or other change.

It is common practice to construct the supports of such structures in the form of mutually engaging cylindrical and plane surfaces, the rolling of the cylindrical surface on the plane surface permitting the relative movement of the structure to its foundation as the dimensional change of the structure occurs to take place. It is important to design the cylindrical and plane surfaces with due regard to the deformation which arises under the influence of the load between them. When the load to be carried is of high value, making it necessary to have a line contact of considerable length, it is difficult to ensure that the cylindrical and plane surfaces intended to be in line contact with one another do not depart from the desired form. Should they so depart, then the load borne along the line of contact is not uniform, and part of the material forming the support becomes more highly stressed than others, and this may result in plastic deformation, i.e. as a result of the stress being beyond the elastic limit of the material, at the more highly stressed parts. Furthermore, the cylindrical and flat members, considered as beams, will be subjected to bending and shear stress under the influence of the load. If the consequent bending and shear deflections are not small compared with that arising from the compression in the material due to the load, the distribution of the load along the nominal line of contact between cylindrical and plane surfaces will not be uniform.

A load-supporting device according to the invention, has relatively movable load supporting surfaces in mutual contact with one another both of substantially cylindrical form, the axes of the cylinders being inclined, and preferably at right-angles, to one another, one of the said surfaces being located on a load-supporting strut which is angularly movable under the influence of the dimensional change of the structure imposing a load on the strut to permit the rolling motion of the two surfaces to take place, while the other is located on a load to be supported.

As mentioned above in connection with cylindrical and plane surfaces, the assumed state of uniform loading of the nominal lines of contact will be vitiated unless the accuracy of alignment and the rigidity of the backing members is extreme. With the cross-cylindrical form of the load supporting surfaces, the effect of errors of alignment will be simply to move the position of the contact and the effect of bending and shear deflections will be to bring the surfaces of the crossed cylinders into closer conformity. This will reduce the stressing of the material. Therefore, if the crossed cylinders are designed so that even assuming absolute rigidity of the rolling members the stresses are insufficient to produce plastic flow, plastic flow cannot occur as a result of the deflections since these reduce the stresses.

There is, of course, a limit to the amount of deflection which can be tolerated and it can be taken as an approximate criterion

[*Price* 3*s*. 6*d*.]

Price 4s 6d

that if all the load were concentrated at the centre points of the rolling surfaces the curvatures assumed by them there, due to their deflections as beams, should be insufficient to overcome the curvature given to the cylindrical member, which according to the invention, replaces the flat member.

The invention is of particular utility in connection with the support of heavy cylindrical or spherical vessels subject to large temperature rises during operation, with the result that their radial or axial dimensions change materially. For such purposes, the supports are constructed in accordance with the invention in order to permit the radial or axial movement between the vessel and the foundation to take place. If the vessel is of cylindrical or spherical form and is supported, in the case of a cylindrical vessel, with its longitudinal axis in a vertical position, the load supports, each incorporating a load-supporting strut which is angularly movable under the influence of the dimensional change of the vessel, will be arranged circumferentially of the vessel. In this arrangement, as expansion of the vessel takes place, the load-supporting struts will move angularly about the vertical. In the case in which a cylindrical vessel is being supported with its axis horizontal, at least one anchorage preferably will be provided to prevent the vessel from moving as a whole, with relation to its foundation.

There will preferably be located at each end of the load-supporting strut, a pair of load-supporting surfaces in contact with one another, both surfaces being in substantially cylindrical form, and the axes of the cylinders being inclined or most simply at right-angles to one another.

The accompanying drawings illustrate an arrangement in which a spherical or cylindrical vessel, with its axis vertical, is supported by struts incorporating load-supporting surfaces in accordance with the invention.

In the drawings, Fig. 1 is a diagrammatic view of the vessel, and Figs. 2 and 3 are respectively an end view and an elevation of a preferred form of strut.

Referring to the drawings, a substantially cylindrical vessel 1 is supported with its longitudinal axis vertical upon a plurality of supporting struts 2, of which four are indicated, from a foundation 3. The struts 2, which are shown in greater detail in Figs. 2 and 3, are of substantially A-form when viewed radially of the vertical axis of the vessel 1 and engage brackets 4 secured to the periphery of the vessel 1. The struts 2 provide at their upper and lower ends cylindrical load-supporting surfaces 5, 6, that at the upper end of each strut being in contact with a co-operating cylindrical load-supporting surface 7 on the lower face of a bracket 4, and those at the lower end being in contact with similar surfaces on the foundation members 8, the axes of the cylinders of which cylindrical load-supporting surfaces in contact with one another are part being substantially at right-angles to one another. The cylindrical load-supporting surfaces thus initially make point contact with one another, the area of contact extending as the load on the co-operating cylindrical load-supporting surfaces increases. The foundation or bearing members 8 are thus spaced along a circular path, the axes of the cylindrical surfaces on the brackets and foundation members being substantially radial to that path, while the corresponding cylindrical surfaces on the strut are substantially tangential to the path.

Since each of the struts 2 provide a pair of load-supporting surfaces at their lower ends, the arrangement indicated is stable in any direction in a horizontal plane, any radial outward movement of the brackets, resulting from expansion of the vessel under the influence of increases in temperature, will be permitted by a slight outward inclination of the struts, the cylindrical load-supporting surfaces in contact with one another then executing a rolling movement at the region of contact.

The A-shaped struts are preferably in the form of box-shaped members, the A plates in parallel spaced relation with one another being connected by end plates forming the box section. The brackets secured to the wall of the vessel by which it is supported from the load-supporting surfaces on the strut will incorporate a sufficient number of spaced vertical plates, shown as two in number in the illustrated arrangement, as is required to accept the load which it carries.

In the case in which a cylindrical vessel is supported with its longitudinal axis in a horizontal position, the struts will be spaced along two parallel lines parallel with the longitudinal axis of the vessel and in order to ensure stability of the vessel, it may be anchored to the foundation at an intermediate region between the lines of struts.

Whilst the load-supporting surfaces in contact with one another in the form of crossed cylinders have been referred to as being of cylindrical form, it is evident that this form is only present when the surfaces are carrying substantially no load; as the vessel and its contents are constructed, and the load on the surfaces increases, the cylindrical surfaces deflect and become progressively flatter; the above description must, therefore, be read with this deflection in view.

The radius of curvature of the cylindrical surfaces on the struts is substantially one half the length of the strut. The radius of the cylindrical supporting surfaces on the

brackets and foundation members should preferably have a large value.

It is evident that the curvatures of the load-supporting surfaces on the strut and brackets or foundation members may be interchanged if desired, making the axes of those on the ends of the strut radial and those on the other surfaces tangential. In this case, the surfaces of smaller radius of curvature will be provided on the bracket and foundation members.

WHAT WE CLAIM IS:—

1. A load supporting device having relatively movable load-supporting surfaces in mutual contact, wherein the load supporting surfaces are of substantially cylindrical form, the axes of the cylinders being inclined, preferably at right angles to one another, one of said surfaces being located on a load supporting strut which is angularly movable under the influence of a dimensional change of a structure imposing the load on the strut resulting in a rolling motion of the two surfaces, while the other is located on a load to be supported.

2. A load supporting device as claimed in Claim 1, in which the load-supporting strut is provided at each end with cylindrical load-supporting surfaces the axes of which are substantially coincident, the load-supporting surfaces on the strut contacting with cylindrical load-supporting surfaces provided by the load and a foundation respectively, the axes of which are inclined to those on the strut.

3. A load-supporting device as claimed in Claim 2, wherein the foundation provides two spaced cylindrical load-supporting surfaces each in mutual contact with a cylindrical load-supporting surface on the strut.

4. A vessel subject to a wide range of temperature variation supported by means of a plurality of spaced load-supporting struts as claimed in Claim 2 or 3 wherein the vessel is provided with brackets each of which rests on the upper end of one of the struts, the brackets being furnished with a load-supporting surface of cylindrical shape, the axis of which is inclined to that of the cylindrical surface at the upper end of the load-supporting strut with which it co-operates.

5. A vessel supported by a plurality of load-supporting struts as claimed in Claim 4, wherein the vessel is of substantially circular shape in horizontal cross-section, the struts being spaced along a circular path and the axes of the cylindrical surfaces on the brackets being substantially radial or tangential to the circular path.

6. A vessel supported by a plurality of load-supporting struts as claimed in Claim 4, wherein the vessel is of substantially cylindrical shape and is supported with its longitudinal axis in a horizontal position, the struts being spaced along two parallel lines, located on either side of, and parallel to, the axis of the vessel.

7. A vessel supported by a plurality of load-supporting struts as claimed in Claim 4, wherein the vessel is of substantially cylindrical shape and is supported with its longitudinal axis in a horizontal position, the struts being spaced along two parallel lines, the axes of the cylindrical surfaces on the brackets being substantially parallel, or at right angles, to the lines, the vessel being anchored to the foundation so as to prevent displacement thereof as a whole relative to the foundation.

8. An arrangement for supporting a substantially cylindrical vessel with its longitudinal axis vertically positioned by means of struts having cylindrical load-supporting surfaces co-operating with cylindrical load-supporting surfaces on the vessel and a foundation respectively, the axes of the cylindrical surfaces in contact being at right angles to one another, substantially as described with reference to the accompanying drawings.

J. W. RIDDING,
Chartered Patent Agent,
64—66 Coleman Street,
London, E.C.2,
Agent for the Applicants.

PROVISIONAL SPECIFICATION.

Improvements relating to Supports for Large Structures.

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This invention relates to the supporting of structures which are subject to extension, e.g. as a result of temperature or other change.

It is common practice to construct the supports of such structures in the form of mutually engaging cylindrical and plane surfaces, the rolling of the cylindrical surface on the plane surface permitting the relative movement of the structure to its foundation as the dimensional change of the structure occurs to take place. It is important to design the cylindrical and plane surfaces with due regard to the deformation which

arises under the influence of the load between them. When the load to be carried is of high value, making it necessary to have a line contact of considerable length, it is difficult to ensure that the cylindrical and plane surfaces intended to be in line with one another do not depart from the desired form. Should they so depart, then the load borne along the line of contact is not uniform, and part of the material forming the support becomes more highly stressed than others, and this may result in plastic deformation, i.e. as a result of the stress being beyond the elastic limit of the material, at the more highly stressed parts. Furthermore, as a result of the non-uniformity of contact along the line, the cylindrical and flat members, considered as beams, will be subjected to bending and shear stress under the influence of the load. If the consequent bending and shear deflections are not small compared with that arising from the compression in the material due to the load, the distribution of the load along the nominal line of contact between cylindrical and plane surfaces will not be uniform.

According to the invention, the load supporting surfaces in mutual contact with one another are both of substantially cylindrical form, the axes of the cylinders being inclined, and preferably at right-angles, to one another, one of the said surfaces being located on a load-supporting strut which is angularly movable under the influence of the dimensional change of the structure to permit the rolling motion of the two surfaces to take place.

As mentioned above in connection with cylindrical and plane surfaces, the assumed state of uniform loading of the nominal lines of contact will be vitiated unless the accuracy of alignment and the rigidity of the backing members is extreme. With the cross-cylindrical form of the load supporting surfaces, the effect of errors of alignment will be simply to move the position of the contact and the effect of bending and shear deflections will be to bring the surfaces of the crossed cylinders into closer conformity. This will reduce the stressing of the material. Therefore, if the crossed cylinders are designed so that even assuming absolute rigidity of the rolling members the stresses are insufficient to produce plastic flow, plastic bow cannot occur as a result of the deflections since these reduce the stresses.

There is, of course, a limit to the amount of deflection which can be tolerated and it can be taken as an approximate criterion that if all the load were concentrated at the centre points of the rolling surfaces the curvatures assumed by them there, due to their deflections as beams, should be insufficient to overcome the curvature given to the cylindrical member, which according to the invention, replaces the flat member.

The invention is of particular utility in connection with the support of heavy cylindrical or spherical vessels subject to large temperature rises during operation, with the result that their radial or axial dimensions change materially. For such purposes the vessel to be supported is anchored at one support or region, and the remaining supports are constructed in accordance with the invention in order to permit the radial or axial movement between the vessel and the foundation to take place. If the vessel is of cylindrical or spherical form and is supported with its longitudinal or diametral axis in a vertical position, the load supports each incorporating a load-supporting strut which is angularly movable under the influence of the dimensional change of the vessel will be arranged circumferentially of the vessel. In this arrangement, as expansion of the vessel takes place, the load-supporting struts will move angularly about the vertical. In the case in which a cylindrical vessel is being supported with its axis horizontal, at least one anchorage preferably will be provided to prevent the vessel from moving as a whole, with relation to its foundation.

There will preferably be located at each end of the load-supporting strut, a pair of load-supporting surfaces in contact with one another, both surfaces being in substantially cylindrical form, and the axes of the cylinders being inclined or most simply at right-angles to one another.

In an arrangement in which a spherical or cylindrical vessel is supported with its axis vertical, as mentioned above, the supporting struts will preferably be of A form when viewed radially of the axis. The apex of the A will provide one of the two load-supporting surfaces of substantially cylindrical form, the axis of the cylinder being tangential to the circumference of the vessel being supported, whilst the vessel itself will provide the second cylindrical load-supporting surface having its axis at right-angles to the first surface and being in contact therewith, the axis of the second cylindrical surface being thereby radially directed. The second surface will be located on a bracket fixed to the wall of the vessel, so as to transfer the load from the vessel to the A-shaped load-supporting strut. At the lower end of each of the limbs of the A-shaped load-supporting strut will be provided a further pair of crossed cylindrical load-supporting surfaces, one of them being secured to the foundation, and the other to the strut. The surface of a member secured to the foundation will then have the axis of the cylinder radially directed with reference to the vessel, whilst the cylindrical surfaces on

the limbs of the A-shaped strut will have their axes tangential or chordwise to the vessel. Increase in the radial dimension of the vessel under the influence of temperature rise will thus be taken by the outward inclination of the A-shaped strut towards the vertical, whilst the provision of the A-shaped strut will ensure against circumferential movement of the vessel, and thus provide stability against rotation of the vessel as a whole, about its vertical axis.

The A-shaped struts will preferably be in the form of box-shaped members, the A plates in parallel spaced relation being connected by end plates forming the box section. The bracket secured to the wall of the vessel and by which it is supported from the load-supporting surfaces, will incorporate a sufficient number of spaced vertical plates, as is required to accept the load which it carries.

Whilst the load-supporting surfaces in contact with one another in the form of crossed cylinders have been referred to as being of cylindrical form, it is evident that this form is only present when the surfaces are carrying substantially no load; as the vessel and its contents are constructed, and the load on the surfaces increases, the cylindrical surfaces deflect and become progressively flatter; the above description must, therefore, be read with this deflection in view.

The radius of the cylindrical supporting surfaces should preferably have a large value. The difficulty of accurately machining a cylindrical surface of large radius may be overcome by the method disclosed in the co-pending Application No. 11510/56.

J. W. RIDDING,
Chartered Patent Agent,
64—66 Coleman Street,
London, E.C.2,
Agent for the Applicants.

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808,739 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

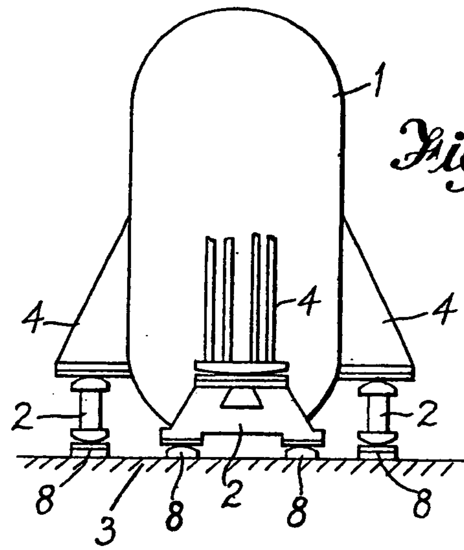
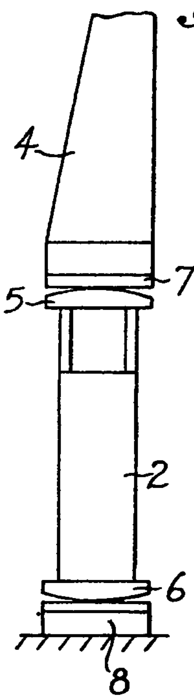


Fig.1

Fig.2



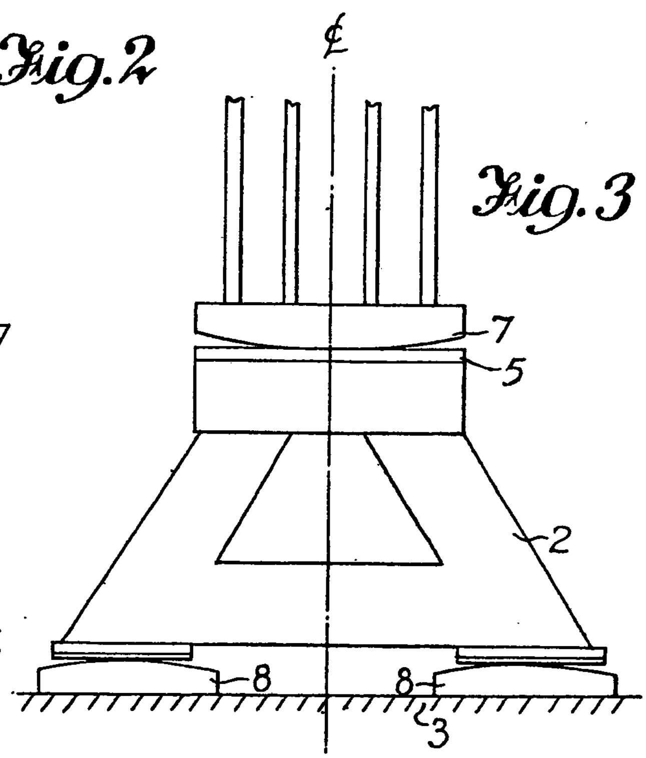


Fig.3